2012-05-01

Cost as a Military Requirement

Gansler, Jacques; Lucyshyn, William; Ziman, David

Monterey, California. Naval Postgraduate School

Cost as a Military Requirement

Jacques S. Gansler , Ph.D.
Professor and Roger C. Lipitz Chair
Director, Center of Public Policy and Private Enterprise
School of Public Policy
University of Maryland

9th Annual Acquisition Research Symposium
Naval Postgraduate School, Monterey, CA
May 17, 2012

Background

The next decade presents multiple new challenges to National Security:

- Changes to the Security Environment
  - Shifting away from large power challengers, such as WWII Germany and the USSR, to “war among the people”; counter-insurgency; counter-terrorism, etc.
  - Prevalence of new domains, such as cyber security
  - Systems must be role-flexible, depending on the mission
- Changes in the Technology Environment
  - Technology continues to evolve rapidly, providing new capabilities
  - Cost efficiency can be a by-product of technologic growth
  - Major systems and subsystems require a design focus (product and process) on affordability and reliability
- Changes to the Budget Environment
  - A growing national debt of $14 trillion
  - Political desire for budget austerity
  - Affordability in acquisitions is now critical

Affordability is Key

"…[T]he budget of the Pentagon almost doubled during the last decade. But our capabilities didn't particularly expand. A lot of that money went into infrastructure and overhead, frankly, I think a culture that had an open checkbook."

Robert Gates
Former Secretary of Defense
Interview on 60 Minutes
May 15, 2011

Affordability will drive DoD's procurement of goods and services in the next decade (unlike post 9/11 decade)

Post-WW II Defense Spending

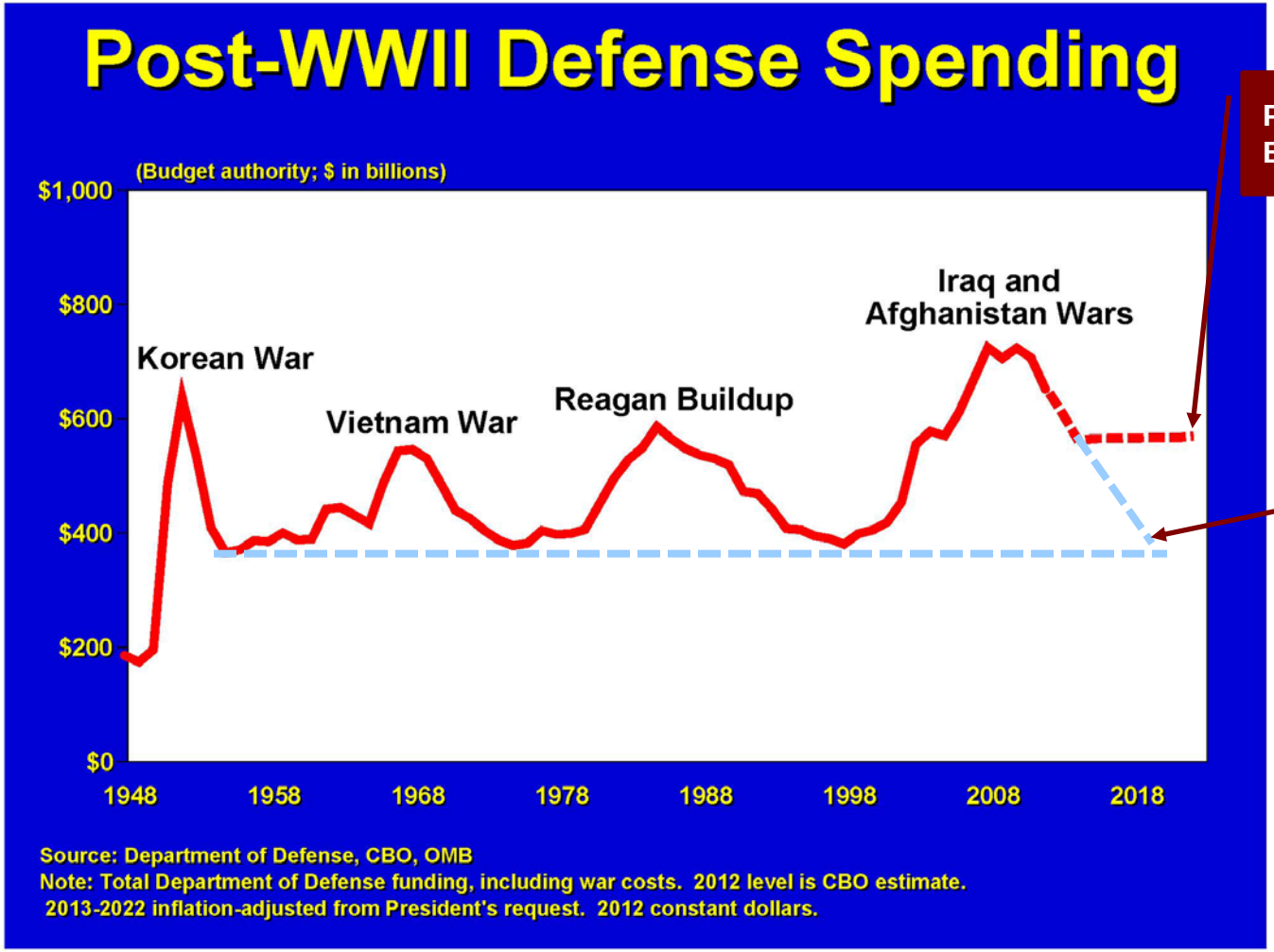
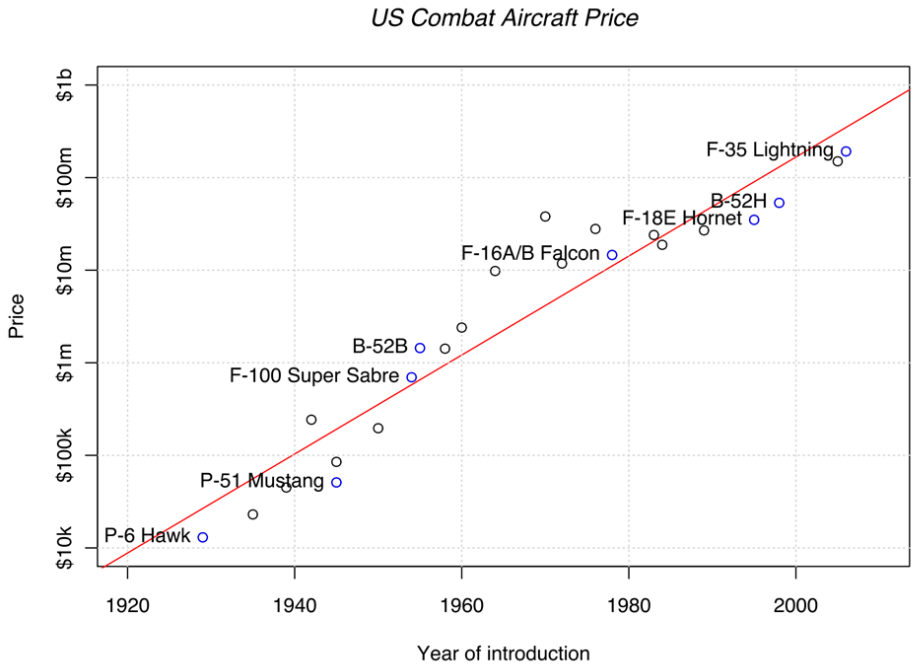
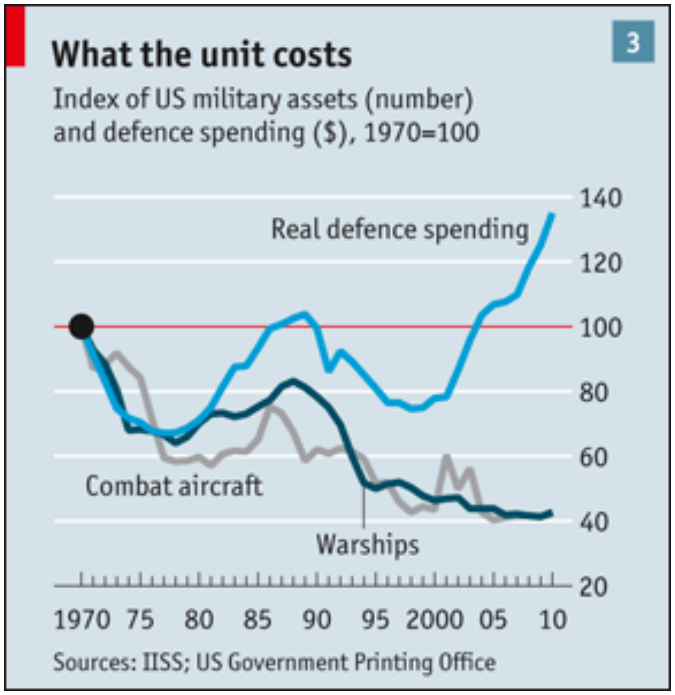


Chart appeared in: Hearing: President's Fiscal Year 2013 Budget Request for Department of Defense (February 28, 2012)

Augustine's 16th law





Two recent examples (in constant 2009 $) of increasing unit costs:

- F-15E: $40.9mil
- F-35A: $116.4mil

"In the year 2054, the entire defense budget will purchase just one aircraft."
Norman Augustine,

Numbers Matter -- Lanchester's Law

- In 1914, Frederick William Lanchester proposed a simple model of combat dynamics to illustrate the principle of concentration of forces.
- Came to be known as "Lanchester's laws," they provide algorithms for predicting the dynamics of attrition in a model of combat.
- "Law" states that force effectiveness is proportional to weapon's effectiveness time the number of weapons squared (which essentially states that the strength of a military unit is proportional not to the number of elements [planes, artillery, tanks, or soldiers], but to the square of the number).

"Quantity has a quality all its own"

- Most often attributed to Lenin, Former Soviet Leader

RQ-4 Global Hawk

- The RQ-4 Global Hawk was developed by Northrop Grumman as an Advanced Concept Technology Demonstration under a DARPA contract -- program makes use of spiral development
- Final block 10 aircraft delivered in mid 2006
- Block 20 saw a significant increase in payload, forcing a redesign due to “requirements creep”
- As requirements grew unit cost grew from initial $15M to $113.9M in July 2011 (then year $)
- Air Force decreased the block 40 purchase from 22 to 11

Key characteristics		
	RQ-4A	RQ-4B
Payload capacity	2,000 pounds	3,000 pounds
Take-off weight	26,750 pounds	32,250 pounds
Wingspan	116.2 feet	130.9 feet
Fuselage length	44.4 feet	47.6 feet
Endurance	31 hours	33 hours
Time at 60,000 feet	14 hours	4 hours
Average speed at 60,000 feet	340 knots	310 knots
Approximate range	10,000 nautical miles	10,000 nautical miles

Joint Strike Fighter / F-35

- The JSF started as a stealthy, low-cost replacement for the F-16 (therefore high volume)
- The JSF had a unit design cost of $35 million
- 11 nations agreed to participate (thus increasing the volume)
- However, “requirement creep” has driven the unit cost to $100-150 million, and LCC estimates continue to rise
- This has caused DoD to cut back on the quantity, and numerous other countries to question their quantity

“ The Joint Strike Fighter Program has been both a scandal and a tragedy.”

- Senator John McCain, LA Times, April 19, 2012


Change Order
YAMAHA

Cost as a requirement

- Converts cost as a consideration to a cost KPP
  - Can be single cost value or threshold
  - This becomes an engineering challenge, not an accounting or auditing problem
  - Requires greater authority to make cost performance trades, since unit cost controls quantity
  - Competition at key decision points helps greatly
- Best results experienced with the following conditions:
  1. Firm Establishment of a unit cost ceiling
  2. Accurate and viable independent cost estimate
  3. Vibrant and Healthy Industrial Base
  4. Explicit incentives for achieving a cost KPP

"The last 10% of performance generates one-third of the cost and two-thirds of the problems"

"Cost" vs. "Price"

- What matters is the unit price paid by the government
- This is driven by:
  - Subsystems and parts costs
  - Overhead
  - R&D, final assembly, and test costs
  - Only minimally by profit
- A "total cost" (i.e. price paid) prospective must be taken in meeting the "cost requirement"

Life-Cycle Costs must also be considered

- Reducing some performance requirements (e.g. reliability) to reach a cost KPP can result in a higher LCC
  - Defeats the affordability benefit of a military cost requirement
- Additionally, LCC drivers, such as fuel use and manning levels of ships, must also be considered, and reduced as much as is practical.
- These may seem like conflicting requirements lower costs and higher performance, but the commercial sector has demonstrated that it can be done

Commercial Sector: Auto Manufacturing

- Driven by market needs, in addition to mission requirements:
  - Multi-price point categories of vehicles and customers
  - Ability to retain customers with quality performance
  - Poor performance or reliability will lose market share
- Car manufacturers use two main methods for cost-control:
  - Cost as a requirement: Cost is determined based on desired performance. Subcomponent sourcing is based on the ability to meet performance/cost requirements.
  - Design to Cost: Cost is determined based on market values, the system is designed and subcomponents are sourced based on the ability to meet that price
- During design, requirements are thresholds, with minimal requirements set
  - No requirements creep
  - Fixed price contracting between component producers, and the vehicle manufacturer
- Ability to ensure sustainable unit cost for each annual model

JDAM Program

- The JDAM System is a tail kit for converting gravity guided munitions to GPS or computer guided munitions
- A key pilot program in DoD's push for using commercial acquisition strategies – granted expedited waiver status (25 in total)
- Program cost figures:
  - Historical system cost estimate: $68,000
  - **Cost requirement**: $ 40,000
  - Realized system cost: $18,000

JDAM

- Cost requirement derived from a cost goal. At insistence of Air Force Chief of Staff, it was made a firm requirement.
- The following strategies were key to the program's success:
  - Government/Contractor Integrated Product Teams (IPTs)
  - Performance based, head-to-head competition
  - Rolling down-select during competition
  - Allowing the contractor control over the technical data package
  - Requiring a contractor-supplied warranty
  - Minimal paperwork and limited, streamlined oversight
  - Negotiations based on supplier price, not cost
  - Primary award criteria based on past performance and best value
  - Allowing trade-offs of price for performance criteria
  - Use of commercial products
  - Firm, fixed price production contracts

Lessons Learned

- Cost requirements are most effective when used as an independent requirement
  - All other requirements can be traded off in favor of maintaining the cost requirement
  - Low cost estimates will reduce the number of suppliers capable of meeting all requirements
  - Allowing higher cost estimates will ensure higher cost
- Threshold requirements for both performance and cost can promote trade space maximization, while limiting requirements creep
  - Requirements creep can result in reduced quantities; and leads to less effective and inefficient systems

Continued →

Lessons Learned (cont.)

- Without use of firm fixed-price production contract methods, gains from cost control will be lost
- Quick verification for requirements criteria is essential when trade space is opened up
  - IPTs prove essential for contracting
  - Including end users in IPTs helps focus the requirement
- Cost as a military requirement promotes the use of evolutionary/spiral development
  - Spiral development is a proven tool to control cost and keep performance attainable (and improving with advancing technology)
  - Incentives (for both industry and government) are very effective motivators

Challenges

Implementation of a military cost requirement faces a **paradigm shift** from **performance** as a top priority, to **cost** with militarily-acceptable performance

- Slow FAR/DFAR waiver process (JDAM program required 33 waivers)
- Requirements Creep
  - Cultural resistance to accepting the "80% solution"
- Lack of cost control incentives
  - Lower system cost results in a smaller contract profit
  - Government personnel are incentivized to grow their programs (larger budget, more personnel etc.) and they receive no benefit from saving money
  - Formal program consequences (Nunn-McCurdy) are rarely invoked or enforced
- Subcomponent sourcing methods (e.g. make or buy)
- Producing accurate and viable independent cost estimates

Recommendations - Systemic

- JROC should change cost from a consideration to a requirement (based on the military requirement for quantity-within resource constraints)
- Requirements should, if possible be established by means of thresholds to encourage trade space
  - Minimally acceptable to highly desired
- Systems should be evaluated based on performance and cost
- Unit costs should be considered in conjunction with total ownership costs
  - Sacrificing reliability to lower unit cost will increase support costs
- USD-AT&L should designate a series of pilot programs by which to implement a cost requirement
  - "Design to cost" pilots could supplement *Should Cost/Will Cost* for cost control reform
- Institute temporary expedited process for FAR/DFAR waivers